Prioritized Technology: Planetary Ascent Vehicle for Sample Return - Mars Ascent Vehicle

Technical Goal

- Decadal states "The Mars Ascent Vehicle (MAV), as part of the MSR-L element is the greatest technology challenge for this decadal period. It must survive both the landing shock and the martian surface thermal environment. The risk of mass and cost growth must be mitigated through an early test program because of its currently low TRL." – Vision and Voyages for Planetary Science in the Decade 2013 – 2022.
- A major technology risk is the both the mass growth of the MAV with sample container mass growth and the lander resource requirements to maintain the MAV for expected duration.
- The goal is to mature the ascent vehicle sufficiently to close the system level design for the MSR-L mission. Technology development is needed to mature a system with both sufficient performance & minimal impact to the lander system.
  - Maturing propulsion and subsystems for increased performance, robustness, reduced mass and/or extended low temperature storage and operation.
  - Minimum quantifiable metric that makes the MAV close are TBD.
    - MAV design closure could be achieved through a combination of small avionics, higher specific impulse, lower temperature operations, etc…, as one area may require a significant improvement if the other areas don't improve much or several areas need to improve just a little.
    - The down select from Hybrid to Solid to Liquid is TBD, and until the OS mass is fixed, it is unknown what solution is best and which of any/all are sufficient.
  - The objective of the MAV technology development is:
    1. Provide a system to meet the mission requirements within the evolved SkyCrane EDL system
    2. Minimize the mass, cost and schedule risk to the MSR-L mission

Mission Applications

- Mars Sample Return – Lander
  - A mature ascent vehicle <u>will enable</u> the MSR-L mission.
- High performance and low storage temperature systems are relevant to:
  - Minimize the burden of limited resources on the lander
  - Minimize MAV components with high gear-ratio of mission impact
  - Minimize mass growth due to sample container growth

Technical Status

- The baseline options for the MAV has been:
  - Two-stage solid motor propulsion system
    - -40°C Operational lower temperature limit
    - ~-55°C Non-operational lower temperature limit
    - 293.3s motor performance
  - Standard S-level avionics packages
- Work has begun on:
  - Single Stage Restartable Hybrid propulsion system
    - >310s performance goal
    - -100°C Non-operational temperature limit
    - Liquid Injection Thrust Vector Control (LITVC)
  - Lightweight and low volume avionics
    - Sphinx Flight Computer (AES)
      - LEON 3 FT Rad Hard
    - MEMs IMUs

Development Cost and Schedule

5/26/17